US005682475A

United States Patent [19]

Johnson et al.

[11] Patent Number: 5,682,475

[45] Date of Patent: Oct. 28, 1997

[54] **METHOD AND SYSTEM FOR VARIABLE PASSWORD ACCESS**

[75] Inventors: **William J. Johnson**, Flower Mound; **Owen W. Weber**, Coppell, both of Tex.

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **366,693**

[22] Filed: **Dec. 30, 1994**

[51] **Int. Cl.**[6] **G06F 11/00**

[52] **U.S. Cl.** **395/188.01**; 395/186; 380/23; 364/222.5; 364/286.4; 364/286.5

[58] **Field of Search** 395/188.01, 186, 395/726, 725, 187.01; 380/4, 24, 25, 23; 364/222.5, 286.5, 261, 286.4, 260.81

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,779,224	10/1988	Moseley et al.	364/900
4,970,504	11/1990	Chen	340/825.31
5,222,231	6/1993	Gunji	395/575
5,323,146	6/1994	Glaschick	340/825.34
5,375,243	12/1994	Parzych et al.	395/725
5,430,867	7/1995	Gunji	395/575
5,475,839	12/1995	Watson et al.	395/650

OTHER PUBLICATIONS

Perry, O. R., Password Verification, IBM Technical Disclosure Bulletin, 11–72, pp. 1943–1944.

Christy, G. et al. Mechanism For Secure Off-Site Computer Access. IBM Technical Disclosure Bulletin, 04–85, pp. 6754–6756.

Dean, M. C. et al, Method To Provide Password Security Without Storing Password, IBM Technical Disclosure Bulletin, 08–87, p. 1068.

Clarke Jr., G. L. et al, Flexible Password Protection Scheme For A C2 Security/Electrically Erasable Programmable Read Only Memory Controller, IBM Technical Disclosure Bulletin, vol. 37, N9, 09–94, pp. 257–260.

Najjar, L. J., Published in International Technology Disclosures, vol. 10, N1, 01–92, Graphical Passwords.

US patent application Ser. No. 07,993,283, filed Dec. 17, 1992, assigned to applicant.

Primary Examiner—Robert W. Beausoliel, Jr.
Assistant Examiner—Dieu-Minh Le
Attorney, Agent, or Firm—Norman L. Gundel

[57] **ABSTRACT**

A method and system are provided for controlling access to a data processing system through the use of a variable password. In one embodiment, the invention substitutes the value of a variable into an expression contained in a predefined password, evaluates the expression and password, and compares the result of the valuation of the password to a character string input to the data processing system, granting access if they are identical. A range of values of certain characters of the password may be permitted. The password may require that certain characters be entered within a defined time interval measured from the entry of other characters. The values of environment variables, which are referenced by the variable password, may change from time to time, as a function, for example, of the current time or temperature or system utilization.

9 Claims, 3 Drawing Sheets

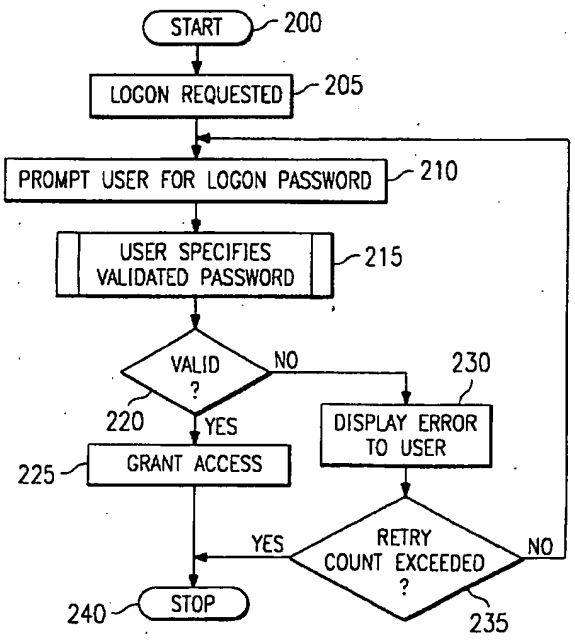
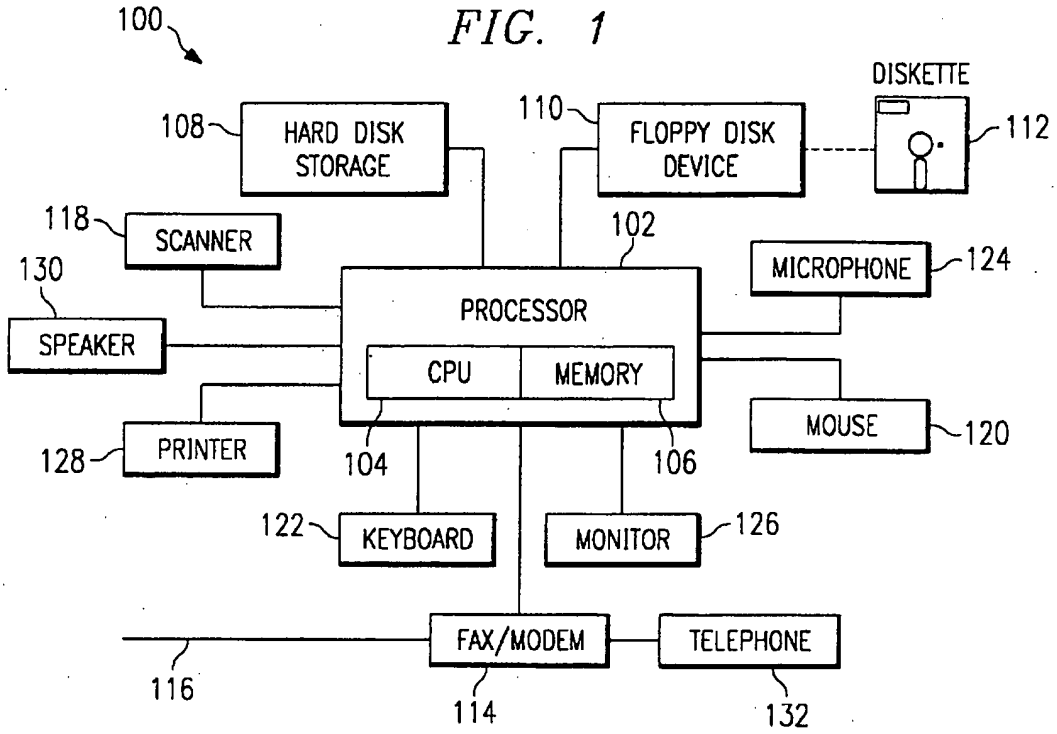


FIG. 1


100
108
HARD DISK STORAGE
110
FLOPPY DISK DEVICE
DISKETTE
112
118
SCANNER
102
130
SPEAKER
PROCESSOR
CPU
MEMORY
MICROPHONE
124
MOUSE
120
128
PRINTER
104
106
122
KEYBOARD
MONITOR
126
FAX/MODEM
TELEPHONE
116
114
132

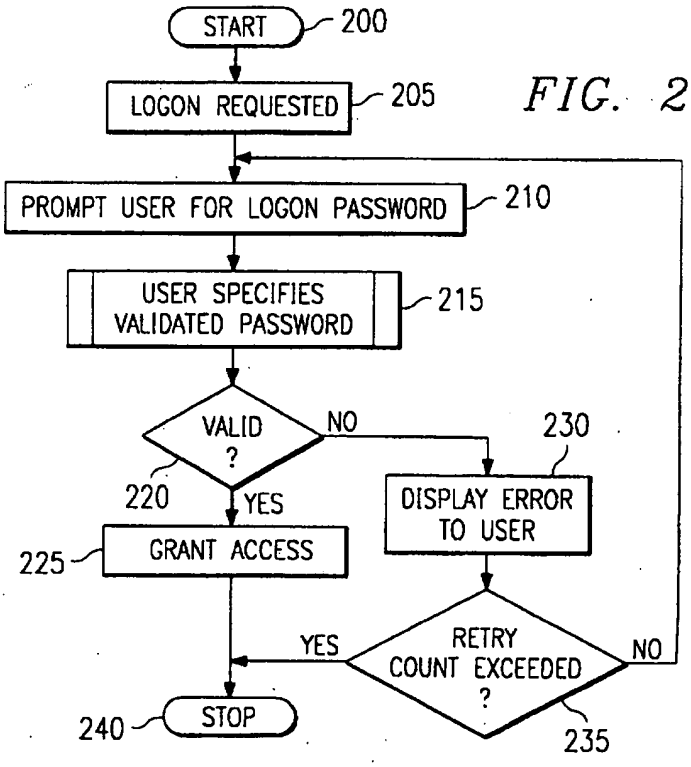

START
200
LOGON REQUESTED
205
PROMPT USER FOR LOGON PASSWORD
210
USER SPECIFIES VALIDATED PASSWORD
215
VALID ?
NO
230
220
YES
DISPLAY ERROR TO USER
225
GRANT ACCESS
YES
RETRY COUNT EXCEEDED ?
NO
240
STOP
235

FIG. 2

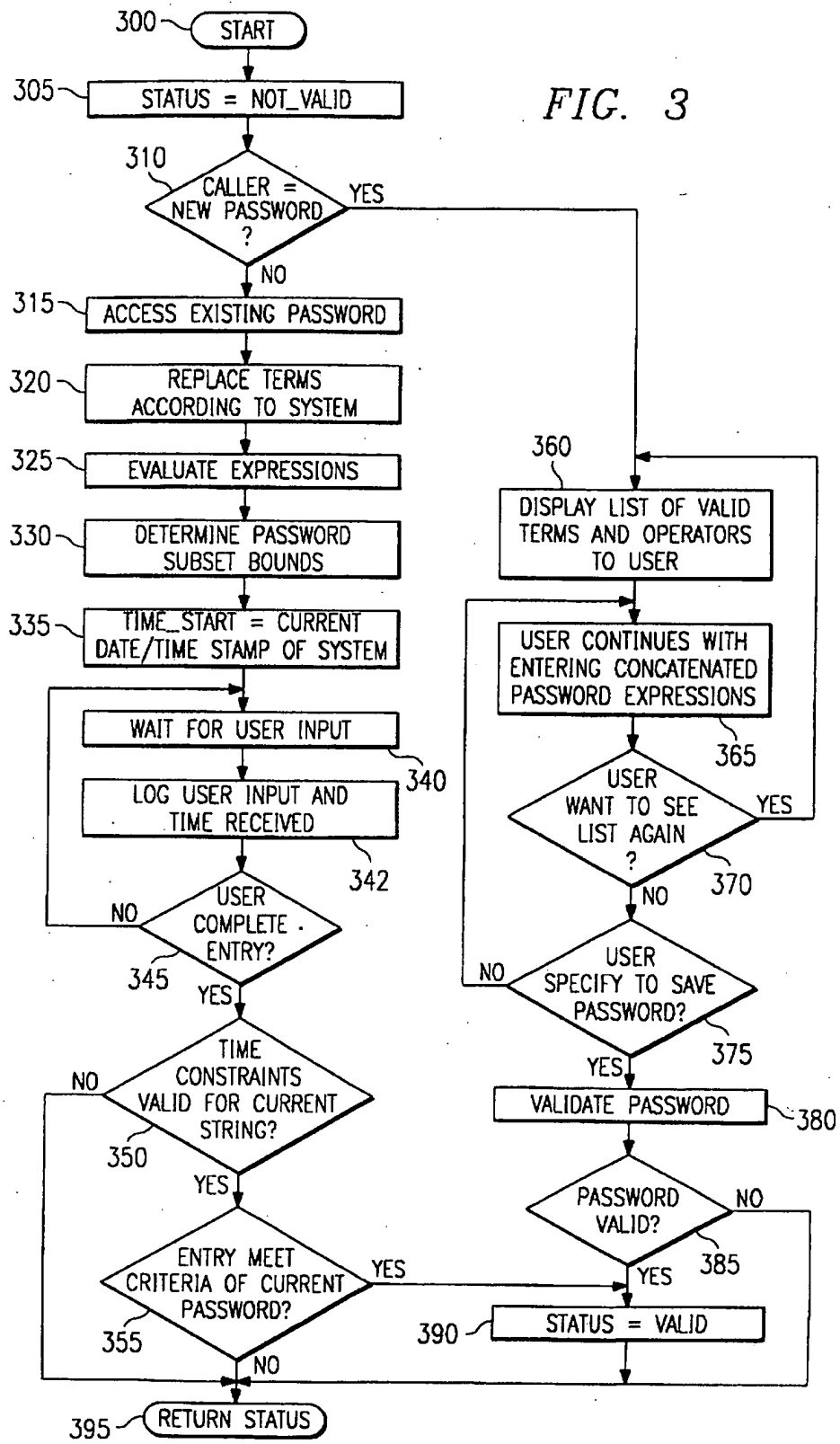
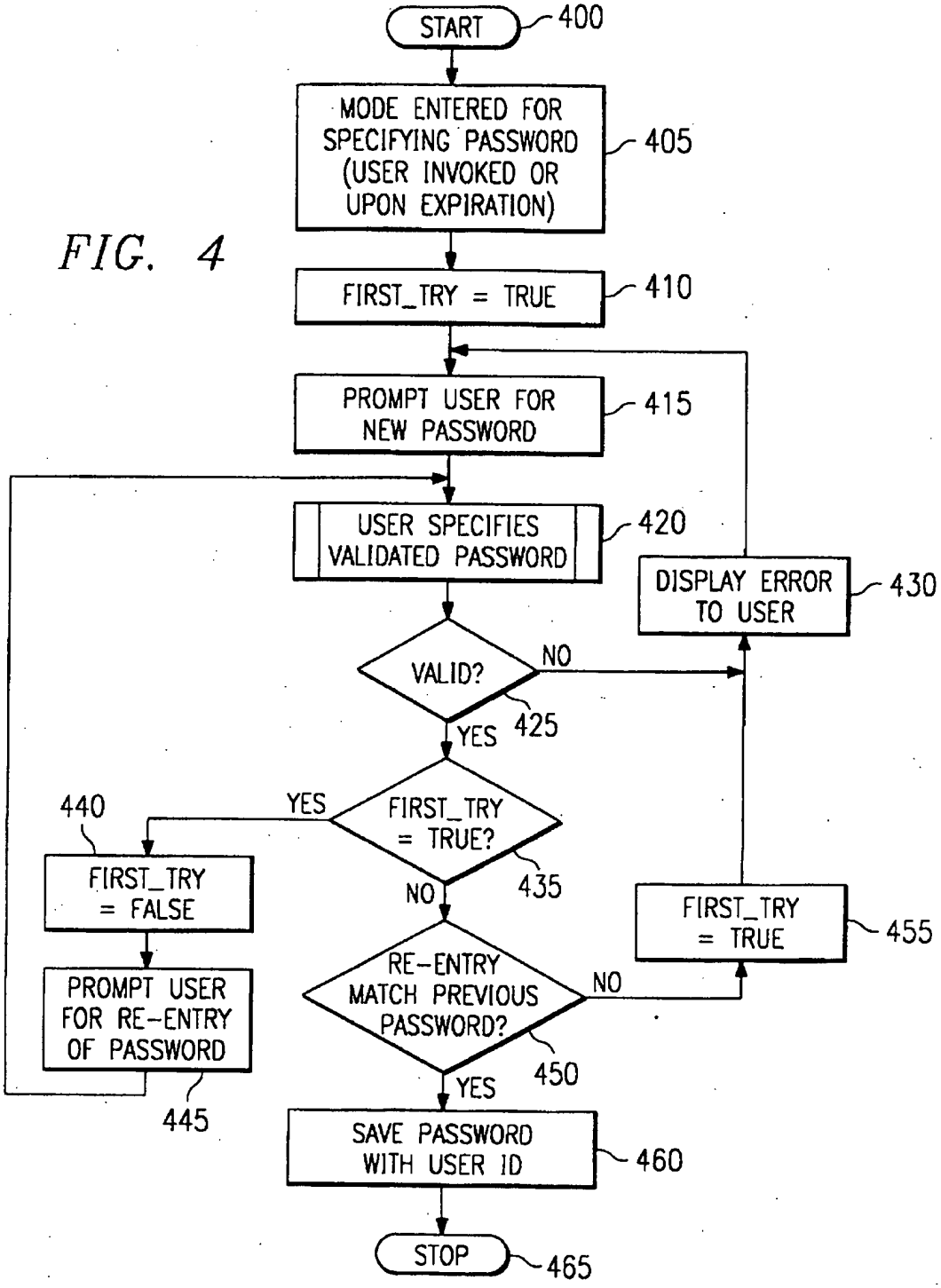

300
START
305
STATUS = NOT_VALID
310
CALLER = NEW PASSWORD ?
YES
NO
315
ACCESS EXISTING PASSWORD
320
REPLACE TERMS ACCORDING TO SYSTEM
325
EVALUATE EXPRESSIONS
330
DETERMINE PASSWORD SUBSET BOUNDS
335
TIME_START = CURRENT DATE/TIME STAMP OF SYSTEM
WAIT FOR USER INPUT
340
LOG USER INPUT AND TIME RECEIVED
342
USER COMPLETE ENTRY?
NO
345
YES
TIME CONSTRAINTS VALID FOR CURRENT STRING?
NO
350
YES
ENTRY MEET CRITERIA OF CURRENT PASSWORD?
YES
355
NO
395
RETURN STATUS
360
DISPLAY LIST OF VALID TERMS AND OPERATORS TO USER
USER CONTINUES WITH ENTERING CONCATENATED PASSWORD EXPRESSIONS
365
USER WANT TO SEE LIST AGAIN ?
YES
370
NO
USER SPECIFY TO SAVE PASSWORD?
NO
375
YES
VALIDATE PASSWORD
380
PASSWORD VALID?
NO
385
YES
390
STATUS = VALID

FIG. 3

FIG. 4


START
400
MODE ENTERED FOR SPECIFYING PASSWORD (USER INVOKED OR UPON EXPIRATION)
405
FIRST_TRY = TRUE
410
PROMPT USER FOR NEW PASSWORD
415
USER SPECIFIES VALIDATED PASSWORD
420
DISPLAY ERROR TO USER
430
VALID?
NO
425
YES
FIRST_TRY = TRUE?
YES
440
435
NO
FIRST_TRY = FALSE
FIRST_TRY = TRUE
455
PROMPT USER FOR RE-ENTRY OF PASSWORD
RE-ENTRY MATCH PREVIOUS PASSWORD?
NO
445
450
YES
SAVE PASSWORD WITH USER ID
460
STOP
465

METHOD AND SYSTEM FOR VARIABLE PASSWORD ACCESS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to data processing system access control and more particularly to access control using a password that varies in accordance with a function.

2. Description of the Related Art

Passwords are used to control access to many different types of data processing systems. Entry of a password may be required to log-on to a network or a host, or to open a standalone application. Entry of a password may be required to access certain data. Entry of a password, called a Personal Identification Number or PIN, may be required for electronic use of a particular debit card or credit card. Entry of a keyed or voiced password may be required for use of telephone answering systems that may be used, for example, to retrieve or record voice mail or to retrieve or conduct financial transactions. Entry of a password may be required for access to buildings.

Entry of a correct password may be sufficient to grant a person or account, called a user, access to a data processing system, Alternatively, the user may be known to the data processing system by a unique userid and that unique userid may have a unique password associated with it. To gain access to the data processing system, the user first enters his userid and then enters his password. The data processing system first determines whether the userid is valid, that is, whether the userid is included among those userids that authorize access to the data processing system. The data processing system then determines whether a password previously associated with the valid userid is the same as the password entered by the user, and if so, grants access.

A password, and a userid if required, may be entered in different ways. A userid may be read from the magnetic stripe of a credit card or identification badge. A fixed alphanumeric password is both convenient and economical. It is easily assigned, changed and cancelled and may be easily entered on existing data processing equipment. An alphanumeric character string may be entered at a typewriter-style keyboard. A numerical password may be keyed into a DTMF tone telephone, upon which number keys may be substituted for alpha characters.

Passwords may be assigned by the data processing system or selected by the user. Password rules may require minimum or maximum lengths or certain character types in certain positions. For example, a data processing system may require a password 6 to 24 alphanumeric characters in length with the first and last characters being alphabetic and at least one of the intervening characters being numeric. Passwords may be valid until voluntarily changed by the user or they may expire, requiring the provision or the selection of a new password. Passwords and userids may be included in sign-on scripts. Data processing system rules may prohibit the inclusion of passwords or userids in sign-on scripts.

However, fixed alphanumeric passwords are vulnerable to security breaches. The keyed entry of a fixed alphanumeric password can be visually observed by unauthorized persons, even where the display of the keyed characters on video displays and printers is suppressed. A password transmitted over telephone or networks can be misdirected or intercepted, either intentionally or inadvertently. Once known to another, the security of a fixed alphanumeric password is compromised, as it may be used repeatedly without authorization until the breach is discovered and corrected, or until it may expire.

Single use alphanumeric passwords seek to minimize the inherent security risk of unauthorized interception and reuse of fixed alphanumeric passwords. A user receives multiple unique passwords, each usable only once. However, a user, who may memorize a single password, is more likely to carry a written list of these multiple passwords, increasing the risk that the list may be compromised. Additionally, the inconvenience of a forgotten password, and the security risks of the process of reissuing passwords, increases with single use passwords.

Fingerprints, voiceprints and photographs may also serve as userids or passwords. Although difficult or impossible to duplicate, they require expensive equipment both to issue and to control access-equipment which may have no other use to the data processing system.

Thus an enhanced security password access control system is needed that retains the economy and convenience of fixed alphanumeric password access control.

SUMMARY OF THE INVENTION

In accordance with the present invention, a method and data processing system are disclosed for controlling access to a data processing system through the use of a variable password. In one embodiment, the invention substitutes the value of a variable into an expression contained in a predefined password, evaluates the expression and password, and compares the result of the valuation of the password to a character string input to the data processing system, granting access if they are identical. A range of values of certain characters of the password may be permitted. The password may require that certain characters be entered within a defined time interval measured from the entry of other characters. The values of environment variables, which are referenced by a variable password, may change from time to time, as a function, for example, of the current time or temperature or system utilization.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative detailed embodiment when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a block diagram of an apparatus used in performing the method of a preferred embodiment of the present invention and forming a part of the apparatus of a preferred embodiment of the present invention;

FIG. 2 is a high level logic flowchart illustrating the method of the present invention for receiving access to a data processing system by entering a variable password;

FIG. 3 is a high level logic flowchart illustrating a subroutine used in both the method of receiving access by entering a variable password of FIG. 2 and the method of specifying a variable password of FIG. 4; and

FIG. 4 is a high level logic flowchart illustrating the method of the present invention for specifying a variable password.

While the invention will be described in connection with a preferred embodiment, it will be understood that the description is not intended to limit the invention to that

embodiment. On the contrary, the invention is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as described by the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the Figures, and in particular with reference to FIG. **1**, there is shown, in block diagram form, a data processing system **100** which may be used to implement the method and apparatus of the present invention. The data processing system **100** may preferably be an IBM PC computer running the IBM OS/2 Warp Version 3 operating system (trademarks of IBM Corp.). The data processing system **100** includes a processor **102**, which includes a central processing unit (CPU) **104** and memory **106**. Additional memory, such as a hard disk file storage **108** and a removable media device **110** may be connected to the processor **102**. Removable media device **110** may read from and, usually, write to removable media **112**. Removable media **112** may be magnetic or optical, such as a floppy diskette or a magnetic tape or a compact disk-read only memory (CD-ROM), which may have computer program code recorded thereon that implements portions of the present invention in the data processing system **100**. Inputs may also be received from a fax/modem **114** or network interface card, which is connected to a telephone line **116** or a local area or wide area network, and from a microphone **124**. The data processing system **100** also includes user interface hardware, such as a mouse **120**, a keyboard **122** and a scanner **118**, for allowing user input to the processor **102**. The data processing system **100** also includes visual display devices, such as a monochrome or color display monitor **126** and a monochrome or color display printer **128**, for rendering visual information. The data processing system may also include an audio display device, such as a speaker **130** for rendering audio information. A telephone **132** may also be connected to the telephone line **116**.

Referring now to FIG. **2**, there is depicted a high level logic flowchart illustrating the operations preferred in carrying out the method of the present invention for receiving access to a data processing system by entering a variable password. The process begins at block **200** and passes to block **205** for receipt of a logon request from the user. The logon request may take the form of the conventional entry of a user identifier to the data processing system, such as a userid entered at a keyboard or read from a credit card, or a terminal ID as furnished by IBM Communications Manager/2 (trademark of IBM Corp.). This user identifier serves as a pointer within the data processing system to a valid password associated with the user identifier. Not all data processing systems associate a password with a user identifier; in some data processing systems, any user who enters a valid password is granted access.

After receiving a logon request, the process passes to block **210** and prompts the user for entry of a logon password. Next, in block **215**, the process passes to the specification of valid password subroutine of FIG. **3** at block **300** for entry and validation of a logon password.

A logon password as used by this invention is a character string formed from a concatenated list of expressions such that each expression derives a resulting character string. In the preferred embodiment, floating point numbers derived from any expression may be truncated to the right of the decimal point and the resulting integer string is used as the derived character string. A password may be made up of one or more expressions and has the following form, in which || is the concatenation operator:

Expression1 || Expression2 || . . . || ExpressionJ

The derived password has the following form:

String1 || String2 || . . . || StringJ

An expression has the following form, in which "op" is an operator:

Term1 op Term2 op . . . op TermK

In the preferred embodiment, valid operators (op) are:

Operators	Description
+	Addition
-	Subtraction
*	Multiplication
/	Division
!	Factorial

Operators are evaluated in conventional order. Parentheses may be used to modify the order of evaluation of operators.

In the preferred embodiment, valid terms include both constants and environment variables. Constants may be individual characters of a keyboard or telephone keypad; preferably, constants are some subset of all possible characters, such as the twenty-six alpha keys and ten numeric keys of a keyboard or the ten number keys of a telephone keypad. Environment variables are not constant, but vary from time to time, preferably as a function of the current time or temperature or system utilization. The preferred embodiment permits the following terms, which include both constants (characters) and environment variables (the other terms):

Terms	Syntax
Characters	none
Relative Date Time	\RDT(time_mask)
Filesize by path	\BYTES(z:\dir1\dirN\filenm.ext)
Number of files by path	\FILES(z:\dir1\. . .\dirN)
Number Processes Running	\PIDS
Number Threads Running	\TIDS
Temperature Fahrenheit	\TEMPF:n
Temperature Celsius	\TEMPC:n

A time mask in the form of YY:MM:DD:HH:MM:SS:mm is used to specify the characters output by the \RDT term. Any legal nonnumeric character in the time mask outputs the value of that time unit for the current date or time. The number of characters determines the number of digits output. Any number in the time mask increases or decreases the output by the value of the number. Blanks in the time mask suppress output of that time unit. Unspecified right positions are assumed blank.

For example, at 3:33 pm on Dec. 30, 1994, the term \RDT(yy::dd) has the value "9430". The term \RDT (:mm::02) has the value "1217" (using 24 hour time, 15+2= 17). The term \RDT(-5::::85) has the value "918" (9 is the last digit of 94-5=89 and 18 is the last two digits of 33+85=118).

If the file c:\config.sys has a filesize of 638 bytes, then the term \BYTES(c:\config.sys) returns "638". A path to a directory may also be specified, thereby returning the sum of all of the file sizes found in the specified directory. The temperature terms allow a range to be defined. Thus, at 74 degrees F, \TEMPF:2 allows 74 plus or minus 2, or a range from "72" to "76".

An expression may be subjected to a time constraint which requires the user to enter the characters that satisfy the

expression within a specified time interval. The time interval, specified in seconds, may be bounded by a minimum time, a maximum time, or both a minimum and a maximum time. If at least two characters must be entered to satisfy the expression, the time interval is measured from the entry of the first to the entry of the last required character. If the time constraint requires entry of only one character, the time interval is measured from the entry of the last character required to satisfy the preceding expression (or, if none, from the password prompt) to the entry of the character required by the time constraint. If no character need be entered to satisfy the time constraint, the time interval is measured from the entry of the last character required to satisfy the preceding expression (or, if none, from the password prompt) to the entry of the first character required to satisfy the next expression (or, if none, to the completion of the entry of the password):

Time constraint \TC(min_time, max_time, Expression)

A password including a time constraint that requires entry of the characters that satisfy Expression2 in an interval of at least five but not more than seven seconds may appear thus:

Expression1 || \TC(5,7,Expression2) || . . . || ExpressionJ

Turning next to FIG. **3**, the subroutine for specification of a valid password is shown. The subroutine is called and begins at block **300**, then sets the variable STATUS to the value NOT_VALID in block **305**. At block **310**, the subroutine then determines from the calling routine whether the subroutine has been called for the purpose of specifying a new password. If not, as where the subroutine has been called by the process of FIG. **2**, the subroutine passes to block **315** and access the existing valid password. As discussed above, a previously entered user identifier may serve as a pointer to the valid password associated with that user identifier.

The password may take the form of the following example:

\RDT(:::02)+\BYTES(c:\config.sys) || \TC(5,7,abcdefg) || \TEMPF:2 || (\PIDS+3) * 5 || xyz

This example will be evaluated at 3:33 pm on Dec. 30, 1994 at 74 degrees F with 4 processes running where the filesize of c:\config.sys is 638 bytes.

The subroutine next passes from block **315** to **320** and replaces terms according to the present state of the data processing system. In the example:

\RDT(:::02)=17

\BYTES(c:\config.sys)=638

\TEMPF:2=74 plus or minus 2

\PIDS=4

Thus, after replacement:

17+638 || abcdefg || 74 || (4+3) * 5 || xyz

The subroutine next passes to block **325** and evaluates the expressions in the password:

655 || abcdefg || 74 || 35 || xyz

and concatenates:

655abcdefg7435xyz

The subroutine then passes to block **330** to determine the password subset bounds such as are imposed by time constraints and allowable ranges. In the example, in the character string abcdefg, the "g" must be entered at least five and not more than seven seconds after the entry of the "a". Similarly, the "4" may be replaced by any digit between "2" and "6".

The subroutine then passes to block **335** and sets the variable TIME_START to the current date and time of the data processing system. The subroutine then passes to block **340** to wait for user input of the password.

After detecting a user input, the subroutine passes to block **342**. The subroutine may also pass to block **342** if a defined period of time passes without receipt of user input. At block **342**, the data processing system logs any user input received and the system time of its receipt, and passes to block **345**.

At block **345**, the subroutine determines whether the user has completed entry of the password. This may typically be performed by detection of the keyboard "enter" key or telephone "#" key, the entry of a certain number of characters, the passage of a defined time interval without the entry of a character or the passage of a time interval since the user was prompted to enter a password. If the user input received does not complete the entry of a password, the subroutine returns to block **340** to await further user input. If the entry of the password is complete, the subroutine passes to block **350**.

At block **350**, the subroutine determines whether the password entered meets any defined time constraints. In the example, the characters "abcdefg" must be entered in an interval of at least five and not more than seven seconds. These are the fourth through tenth characters of the password. The subroutine thus determines, from the log of user input and time received of block **342**, whether the tenth character was entered at least five but not more than seven seconds after the time that the fourth character was entered.

If all defined time constraints are not met, the subroutine passes to block **395** and returns the value of the STATUS variable to the calling process of FIG. **2**. This value was previously set to "NOT_VALID" in block **305**. The subroutine also returns control to the calling process of FIG. **2** at block **220**. If, instead, all defined time constraints are met, the subroutine passes from block **350** to block **355**.

In block **355**, the subroutine determines whether the characters received in block **340** and logged in block **342** match the characters required after evaluation in block **325** within the bounds determined in block **330**. In the example, the following characters are required:

655abcdefg7435xyz

However, the subroutine permits the twelfth character, a "4" to vary from "2" to "6" and still meet the criteria

If the subroutine determines that the criteria are not met, the subroutine passes to block **395** and returns the value of the STATUS variable to the calling process of FIG. **2**. This value was previously set to "NOT_VALID" in block **305**. However, if the subroutine determines that the criteria are met, the subroutine passes to block **390** and sets the variable STATUS to "VALID". The process proceeds to block **395** and returns the value of the STATUS variable to the calling process of FIG. **2**. In either event, the subroutine returns control to the calling process of FIG. **2** at block **220**.

Turning again to FIG. **2**, block **220** determines whether the returned status is valid or not. If the status returned by the subroutine is "VALID", the process passes to block **225** and grants access to the user, and then passes to block **240** and terminates. If the status returned by the subroutine is not "VALID", the process proceeds from block **220** to block **230** and displays an error message to the user. The process then passes to block **235** and determines whether a retry count of the number of permitted attempts to enter the password has been exceeded. If not, the process returns to block **210** and prompts the user for entry of the logon password. If the retry count has been exceeded, the process terminates.

With reference now to FIG. **4**, there is depicted a high level logic flowchart which illustrates the method of a preferred embodiment of the present invention for specifying a variable password. The process begins at block **400**, typically after access to the data processing system has been

received, as by the process described in FIG. 2. From block 400, the process passes to block 405 and enters a mode for specifying a new password. This mode may be entered either by user election or upon the expiration of a time period since the specification of the current password.

The process then passes to block 410 and sets the value of the variable FIRST_TRY to "TRUE". The process then passes to block 415 and prompts the user for entry of the new password. Upon receipt of the user input password, the process passes to block 420 and calls the subroutine of FIG. 3 at block 300.

Turning again to FIG. 3, the subroutine is called and begins at block 300, then sets the variable STATUS to the value NOT_VALID in block 305. At block 310, the subroutine then determines from the calling routine whether the subroutine has been called for the purpose of specifying a new password. If so, as where the subroutine has been called by the process of FIG. 4, the subroutine passes to block 360 and displays a list of valid terms and operators to use. An example of such a list is set forth above following the first reference to the subroutine of FIG. 3.

From block 360, the subroutine proceeds to block 365 and allows the user to enter the terms and operators that form the expressions used to define the password, as described above. The subroutine then passes to block 370 to determine whether the user wishes to see the list of terms and operators again. if so, the subroutine returns to block 360, described above. if not the subroutine passes to block 375 to determine whether the user has specified to save the password, completing its entry. If not, the subroutine returns to block 365 to permit further user entry.

If the user has specified to save the password, the subroutine proceeds from block 375 to block 380 to validate the password by determining whether the password input by the user is syntactically correct in accordance with the rules of the various permitted operators, terms expressions, time constraints and concatenations, as described above. The subroutine then passes to block 385 and, if the subroutine determines that the password is not valid, the subroutine passes from block 385 to block 395 and returns the value of the STATUS variable to the calling process of FIG. 4. This value was previously set to "NOT_VALID" in block 305. However, if the subroutine determines that the password is valid, the subroutine passes from block 385 to block 390 and sets the variable STATUS to "VALID". The subroutine proceeds to block 395 and returns the value of the STATUS variable to the calling process of FIG. 4. In either event, the subroutine returns control to the calling process of FIG. 4 at block 425.

Turning again to FIG. 4, block 425 determines whether the returned status is valid or not. If the status returned by the subroutine is not "VALID", the process proceeds from block 425 to block 430 and displays an error message to the user. The process then returns to block 415 and prompts the user for entry of a new password.

If the status returned by the subroutine is "VALID", the process passes from block 425 to block 435 and determines whether the value of the variable FIRST_TRY is "TRUE". If so, the process passes to block 440 and sets the value of the variable FIRST_TRY to "FALSE". The process then passes to block 445 and prompts the user to reenter the password, and then passes to the subroutine of FIG. 3 at block 300, as described above. Upon completion, the subroutine returns control to block 425 of FIG. 4, also as described above.

Turning again to block 435 of FIG. 4, if the process determines that the value of the variable FIRST_TRY is not "TRUE", the process passes to block 450 to determine whether the most recent valid new password entered matches the previously entered valid new password. If not, the process passes to block 455, sets the value of the variable FIRST_TRY to "TRUE", and then returns to block 415 and prompts the user for entry of the new password.

If the most recent and the previously entered valid new passwords match, the process passes from block 450 to block 460. There, the valid new password is saved in association with the proper user identifier, if used, replacing any previous password. The process then proceeds to block 465 and terminates.

Other operators, such as <, >, <=, >=, AND, OR, XOR, and so forth may be implemented to produce numerical Boolean results such as "1" or "0" for character positions in a password. Many operators, including exponentiation, summation, and so forth may be implemented without departing from the Spirit and scope of the invention. Furthermore, many possible forms of environment variables may exist in a particular environment and the examples illustrated herein are not meant to limit the scope of the invention.

While the invention has been particularly shown and described with reference to a preferred embodiment and process, it will be understood that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method, performed in a data processing system, for granting access to the data processing system, said data processing system including a predefined time interval, an environment variable, and a multiple character stored password, said stored password having specified first and second characters and a specification of a third character whose identity is dependent upon a value of the environment variable and an arithmetic operation to be performed upon the environment variable such that the identity of the third character is not equal to the value of the environment variable, wherein said third character may be one of said first and second characters, the method comprising the computer implemented steps of:

accepting an input of a multiple character keyed-in password, said keyed-in password including characters that correspond to the specified first and second characters of the stored password, said keyed-in password further including a character corresponding to the third character of the stored password;

determining whether the identity of the character corresponding to the third character of the stored password is equal to the result of performing the arithmetic operation on the environment variable;

determining the length of time elapsed between the inputting of the corresponding first character of the keyed-in password and the inputting of the corresponding second character of the keyed-in password; and

granting access to the data processing system if the determined length of time elapsed is within the predefined time interval and if the identity of the character corresponding to the third character of the stored password is equal to the result of performing the arithmetic operation on the environment variable.

2. The method of claim 1 wherein the predefined time interval includes a predefined range of time.

3. The method of claim 1 wherein the value of the environment variable includes a range of values and wherein the value of the character whose identity is dependent upon the value of the environment variable also includes a range of values.

4. A data processing system, comprising:

a predefined time interval;

an environment variable;

a multiple character stored password, said stored password having specified first and second characters and a specification of a third character whose identity is dependent upon a value of the environment variable and an arithmetic operation to be performed upon the environment variable such that the identity of the third character is not equal to the value of the environment variable, wherein said third character may be one of said first and second characters;

means for accepting an input of a multiple character keyed-in password, said keyed-in password including characters that correspond to the specified first and second characters of the stored password, said keyed-in password further including a character corresponding to the third character of the stored password;

means for determining whether the identity of the character corresponding to the third character of the stored password is equal to the result of performing the arithmetic operation on the environment variable;

means for determining the length of time elapsed between the inputting of the corresponding first character of the keyed-in password and the inputting of the corresponding second character of the keyed-in password; and

means for granting access to the data processing system if the determined length of time elapsed is within the predefined time interval and if the identity of the character corresponding to the third character of the stored password is equal to the result of performing the arithmetic operation on the environment variable.

5. The data processing system of claim 4 wherein the predefined time interval includes a predefined range of time.

6. The data processing system of claim 4 wherein the value of the environment variable includes a range of values and wherein the value of the character whose identity is dependent upon the value of the environment variable also includes a range of values.

7. A computer program product, for use in a data processing system, for granting access to the data processing system, said data processing system including a predefined time interval, an environment variable, and a multiple character stored password, said stored password having specified first and second characters and a specification of a third character whose identity is dependent upon a value of the environment variable and an arithmetic operation to be performed upon the environment variable such that the identity of the third character is not equal to the value of the environment variable, wherein said third character may be one of said first and second characters, the computer program product comprising:

a computer usable medium having computer readable program code embodied in said medium for granting access to the data processing system, said computer program product including:

computer readable program code means for accepting an input of a multiple character keyed-in password, said keyed-in password including characters that correspond to the specified first and second characters of the stored password, said keyed-in password further including a character corresponding to the third character of the stored password;

computer readable program code means for determining whether the identity of the character corresponding to the third character of the stored password is equal to the result of performing the arithmetic operation on the environment variable;

computer readable program code means for determining the length of time elapsed between the inputting of the corresponding first character of the keyed-in password and the inputting of the corresponding second character of the keyed-in password; and

computer readable program code means for granting access to the data processing system if the determined length of time elapsed is within the predefined time interval and if the identity of the character corresponding to the third character of the stored password is equal to the result of performing the arithmetic operation on the environment variable.

8. The computer program product of claim 7 wherein the predefined time interval includes a predefined range of time.

9. The computer program product of claim 7 wherein the value of the environment variable includes a range of values and wherein the value of the character whose identity is dependent upon the value of the environment variable also includes a range of values.

* * * * *

US006360326B1

(12) **United States Patent**
Hiles

(10) **Patent No.: US 6,360,326 B1**
(45) **Date of Patent: Mar. 19, 2002**

(54) **PASSWORD DELAY**

(75) Inventor: **Paul Hiles**, Tomball, TX (US)

(73) Assignee: **Compaq Information Technologies Group, L.P.**, Houston, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/150,164**

(22) Filed: **Sep. 9, 1998**

(51) **Int. Cl.**[7] **H04L 9/32**; G06F 1/32
(52) **U.S. Cl.** **713/202**; 713/323
(58) **Field of Search** 713/200, 201, 713/202, 300, 323, 324, 1, 2, 320; 710/15, 18, 17

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,555,373 A * 9/1996 Dayan et al. 713/202
5,875,345 A * 2/1999 Naito et al. 713/202
6,121,962 A * 9/2000 Hwang 713/202

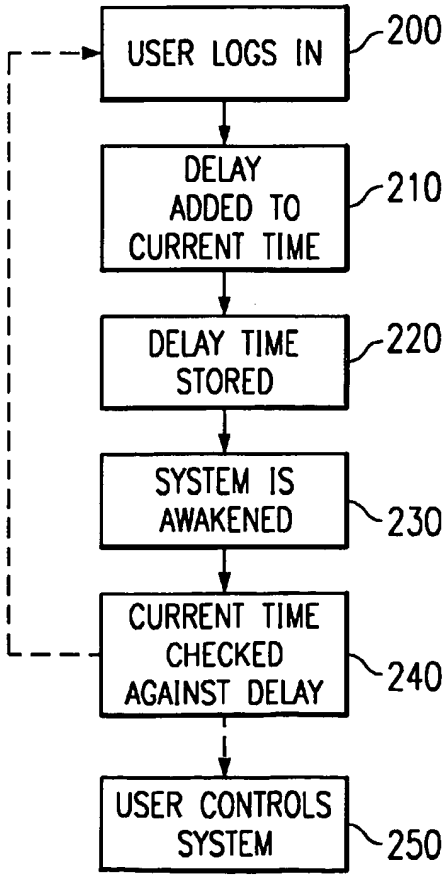
* cited by examiner

Primary Examiner—Gail Hayes
Assistant Examiner—Christopher Revak
(74) *Attorney, Agent, or Firm*—Conley, Rose & Tayon, P.C.

(57) **ABSTRACT**

An innovative security system in which the need to "unlock" the system is eliminated if the system is awakened within a predetermined duration from its last use. In the preferred embodiment, when the user "logs onto" a system by activating it and entering his password, the time of login, plus a predetermined delay, is stored in nonvolatile memory. Thereafter, if the system is placed (or places itself) into a low-power mode, no password will be required to log onto the system if the logon is made before the time stored in nonvolatile memory. If the logon is attempted after this time, the user must go through the entire authorization procedure.

10 Claims, 1 Drawing Sheet



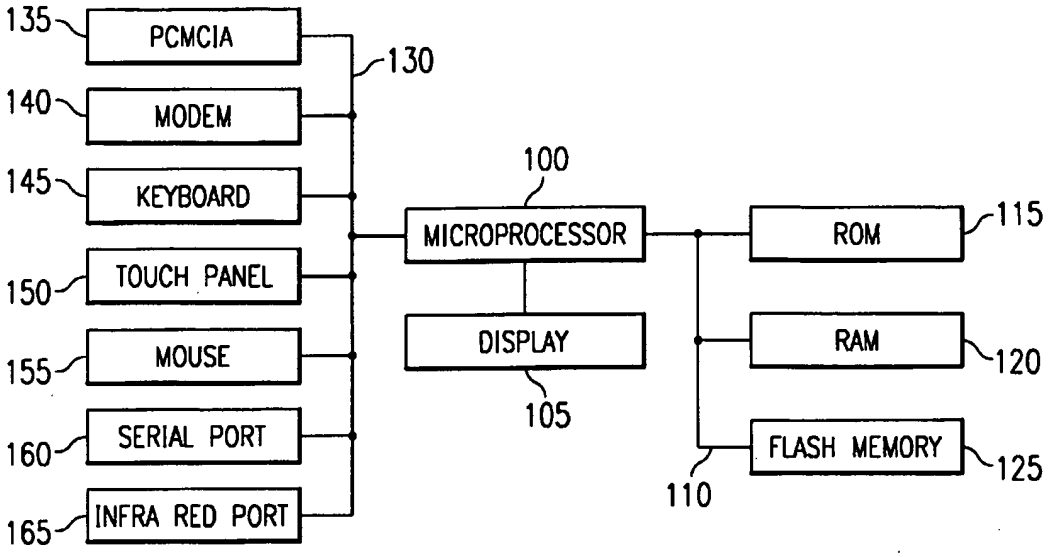

135
PCMCIA
130
140
MODEM
145
KEYBOARD
100
MICROPROCESSOR
ROM
115
150
TOUCH PANEL
DISPLAY
RAM
120
155
MOUSE
105
160
SERIAL PORT
FLASH MEMORY
125
110
165
INFRA RED PORT

FIG. 1

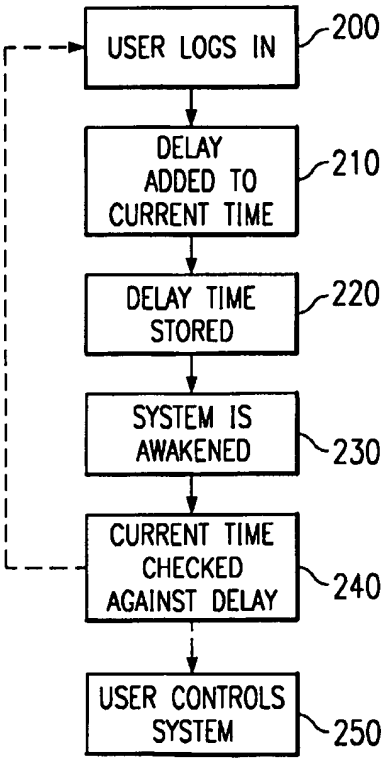

USER LOGS IN
200
DELAY ADDED TO CURRENT TIME
210
DELAY TIME STORED
220
SYSTEM IS AWAKENED
230
CURRENT TIME CHECKED AGAINST DELAY
240
USER CONTROLS SYSTEM
250

FIG. 2

PASSWORD DELAY

BACKGROUND AND SUMMARY OF THE INVENTION

This application relates to computer system security, and in particular to password protection systems in handheld computer systems.

Background: Handheld Computer Systems

As computer technology advances, computer systems are becoming at the same time both smaller and more powerful. Far from traditional calculators or simple address books, today's handheld computers often incorporate full scale word processing, spreadsheet, and database systems. These systems typically include modified versions of the same operating systems found in portable or desktop computer systems, and are able to load and execute any number of different software applications. In addition, many companies use specialized handheld computers for everything from technical support database management to on-the-road communications, and everything in between. In short, it is becoming possible, and even common, for handheld computers to be used for all functions for which traditional desktop or portable systems had been used, but with the natural advantage of greatly increased portability and convenience.

Background: Security in Portable and Handheld Systems

One trade-off for the convenience of handheld and portable computer systems is that the systems are naturally more vulnerable to both theft and compromised data security. Many systems have been proposed for increasing the physical security of these systems, another issue is that of securing the system from unauthorized use, both in case of theft, or in case the system has simply been left unattended for a short time.

In response, many (or even most) portable and handheld computer systems now include some form of password security system. Typically, and at the very least, these systems include the option to require a password to be entered either when the system is first started, or when a user first logs on to the system. Both of these approaches have the disadvantage of leaving the system completely unprotected once the password has been entered for the first time.

Additionally, many systems now include password security systems that activate when the system enters a low-power suspend mode or when a screen saver is activated. These systems are naturally more secure, since when they are left unattended for any length of time, the password system will be activated, and the user must enter a password before the system can be used.

This approach has a significant disadvantage, however. If the system is used in an environment where it is used intermittently and set aside in the mean time, the system will tend to lock itself every time it is not being actively used. While this does in fact increase security, it will slow down the user by requiring him to enter a password every time he needs to use the system. Because of this, the user is much more likely to simply deactivate the password security system rather than have to enter a password each time. Therefore, conventional systems generally force the user to make a difficult choice between convenience and security.

Innovative Computer Security System

This application discloses an innovative security system in which the need to "unlock" the system is eliminated if the system is awakened within a predetermined duration from its last use. In the preferred embodiment, when the user "logs onto" a system by activating it and entering his password, the time of login, plus a predetermined delay, is stored in nonvolatile memory. Thereafter, if the system is placed (or places itself) into a low-power mode, no password will be required to log onto the system if the logon is made before the time stored in nonvolatile memory. If the logon is attempted after this time, the user must go through the entire authorization procedure.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed inventions will be described with reference to the accompanying drawings, which show important sample embodiments of the invention and which are incorporated in the specification hereof by reference, wherein:

FIG. 1 shows a block diagram of a handheld computer system according to the presently preferred embodiment.

FIG. 2 shows a flowchart of the process of the presently preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The numerous innovative teachings of the present application will be described with particular reference to the presently preferred embodiment. However, it should be understood that this class of embodiments provides only a few examples of the many advantageous uses of the innovative teachings herein. In general, statements made in the specification of the present application do not necessarily delimit any of the various claimed inventions. Moreover, some statements may apply to some inventive features but not to others.

The preferred embodiment comprises a configurable delay integrated with a computer system's password security system. A programmable delay figure is added to the current time and stored whenever a user enters a password. If the system is subsequently shut down and then restarted within the specified delay period, no new password must be entered. In effect, the programmable delay allows the user to specify a period, after a password has been entered, in which the password security feature is temporarily disabled.

In the preferred embodiment, the user is able to select from a number of delay length choices. These include 15 min., 30 min., 1 hr., 2 hr., 4 hr., and OFF. Of course, it is possible to allow the user to select any delay period at all, and remain within the spirit of the invention.

In practice, according to the preferred embodiment, the following actions are taken:

A. The user configures the system, as described below, to his chosen delay time.

B. The next time the user logs into the system, using a password, the delay time is added to the current system time and the resulting time is stored in non-volatile memory.

C. Each subsequent time the user attempts to log into the system, provided that the password delay feature is enabled, the security system checks the system time against the saved time, and if that time period has not expired, it bypasses the security password screen.

D. Once the time period has expired, the login security screen is re-enabled and the user must enter the correct password to gain access to the device.

In the preferred embodiment, in order to configure the delay time, a Password Control applet is provided in the operating system's "control panel" application. In this applet the configured password delay time is set using a drop-down

list box control, where the user can select one of the standard options. In this embodiment, the available choices are OFF, 15 minutes, 30 minutes, 1 hour, 2 hours, or 4 hours. If the user selects "OFF" then the password delay feature is disabled. Of course, the choices described here are merely exemplary, and this innovative feature works well with any delay time the user might choose.

The user may be required to log into the system, as in step C. above, by a number of different factors. For example, if the system places itself into a reduced-power or suspend mode, either manually or after a specific duration from last use, the user may be required to log back into the system to resume using it. Alternatively, the system may simply activate a "screen saver" when it is not being actively used, in order to preserve the display, and require the user to log in to resume using the system. In either case, and in many other possible cases, the preferred embodiment would allow the user to operate the system without logging in again if he does so before the password delay time has expired.

Alternate Embodiment: Delay Based On Shutdown

In an alternate embodiment, the selected delay value is used to indicate the amount of time after system shutdown that the security system will be disabled. In this embodiment, when the system enters a low-power state, whether by being placed there by the user or automatically to conserve power, it first adds the user-selected delay time to the current system time and stores the result in memory. Thereafter, as above, when a user attempts to log into the device, the current time and the stored time are compared, and if that time period has not expired, the system bypasses the security password system.

Because, in this embodiment, the stored time is calculated as the system is shut down, the programmable disabling of the security system is measured by the amount of time the system has been shut down (or placed in a reduced-power state), not by when the system was last logged on. This embodiment provides a significant advantage when a system is used constantly over a substantial amount of time, but is set aside for a relatively short amount of time as the user switches tasks, takes a break, etc.

Alternate Embodiment: Non-Volatile Storage of Delay Time

According to an alternate embodiment, the storage of the delay time is done in non-volatile memory. This provides particular advantages in systems, such as conventional portable or desktop computers, in which the system is powered down completely (placed in an OFF state) or removed from power altogether. This embodiment would also be useful in portable or handheld computers that must have the power temporarily removed while batteries are changed.

FIG. **1** shows a block diagram of a computer system according to the preferred embodiment. In this figure, the system microprocessor **100** is connected to control the display **105**. Connected to the microprocessor via a high-speed internal bus **110** to the system memory, which includes ROM **115**, RAM **120**, and FLASH memory **125**. The microprocessor is also connected, via a second bus **130**, to control a variety of optional peripherals. These include PCMCIA port **135**, modem **140**, keyboard **145**, touch panel **150**, mouse **155**, serial port **160**, and infrared port **165**. Note that this is simply an exemplary system, and many modifications of the basic system may be made which still take full advantage of the claimed features. For example, a touch sensitive display screen may be used, which combines the function of the display, keyboard, touchpanel, and mouse.

FIG. **2** shows a flowchart of the innovative password delay security system according to the preferred embodiment. In this flowchart, it is assumed that the delay time is already configured as described above. When the user logs into the system using an appropriate password (step **200**), the system adds the preconfigured password delay time to the current system time (step **210**). The system stores this sum in RAM (step **220**) or in a non-volatile memory. Thereafter, when the user stops using the device for a given period of time, e.g. 5 minutes, the system automatically enters a low power state. When the user next awakens the system to resume using it (step **230**) the system first checks the current system time against the sum stored in step **220** (step **240**). If the current time is not yet past the stored time, the user is given control of the system without any further security checks (step **250**). If the current time is past the stored time, however, the user is forced to go back through the password security system before he is able to operate the system (step **200**). When he has done so, the innovative password delay technique is repeated.

According to one disclosed class of innovative embodiments, there is provided a computer system, comprising: a user input device, a microprocessor which is operatively connected to detect inputs from said input device, random-access memory which is connected to be read/write accessible by said microprocessor, and an output device operatively connected to receive outputs from said microprocessor; and a power supply connected to provide power to said microprocessor and said memory; wherein when said system is not actively used for a given period of time, said system requires a user to enter a password before allowing said user to operate said system; wherein if a fixed amount of time since a password was entered has not expired, then said user will not be required to reenter said password.

According to another disclosed class of innovative embodiments, there is provided a computer system, comprising: at least one input device and at least one output device; a main system module which does not include said input and output devices, and which includes therein: at least one microprocessor which is operatively connected to detect inputs from said input device and to send data to said output device, and random-access memory which is connected to be read/write accessible by said microprocessor; a real-time clock connected to said main system module; wherein when a user logs into said system by entering a password, a value representing the current time plus a configurable delay figure is stored in said memory; wherein at least some security features of said system are disabled whenever the current time, as represented by said real-time clock, is less than said value.

According to another disclosed class of innovative embodiments, there is provided a method, comprising the steps of: requiring a user to enter a password to operate a computer system; storing a value representing the current time plus a configurable delay period in memory; when said system has been idle for a given period of time, placing said system in a reduced-power mode; when a user attempts to operate said system, comparing the current time with said stored value; if the current time has passed said stored value, then proceeding to the first step; if the current time has not passed said stored value, then allowing said user to operate said system.

Modifications and Variations

As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a tremendous range of applications, and accordingly the scope of patented subject matter is not limited by any of the specific exemplary teachings given.

Of course, the innovative teachings of the present application are not limited to any specific hardware or operating system. In fact, this innovative password delay feature may find application in any system which uses an authentication system and is used sporadically.

In the sample computer system embodiment the user input devices can alternatively include a trackball, a joystick, a 3D position sensor, voice recognition inputs, or other inputs. Similarly, the output devices can optionally include speakers, a display (or merely a display driver), a modem, or other outputs.

What is claimed is:

1. A computer system, comprising:

at least one input device and at least one output device;

a main system module which does not include said input and output devices, and which includes therein: at least one microprocessor which is operatively connected to detect inputs from said input device and to send data to said output device, and random-access memory which is connected to be read/write accessible by said microprocessor;

a real-time clock connected to said main system module;

wherein when a user logs into said system by entering a password, a value representing the current time plus a configurable delay figure is stored in said memory;

wherein at least some security features of said system are disabled whenever the current time, as represented by said real-time clock, is less than said value.

2. The system of claim **1**, wherein said system is power by a battery.

3. The system of claim **1**, wherein said system is a portable computer system.

4. The system of claim **1**, wherein said system is a handheld computer system.

5. The system of claim **1**, wherein said value is stored in a non-volatile memory.

6. The system of claim **1**, wherein said system enters a reduced-power state when not actively used for a given period of time.

7. A method, comprising the steps of:

(a.) requiring a user to enter a password to operate a computer system;

(b.) storing a value representing the current time plus a configurable delay period in memory;

(c.) when said system has been idle for a given period of time, placing said system in a reduced-power mode;

(d.) when a user attempts to operate said system, comparing the current time with said stored value;

(e.) if the current time has passed said stored value, then proceeding to step (a);

(f.) if the current time has not passed said stored value, then allowing said user to operate said system; wherein said stored value is determined at step (a).

8. The method of claim **7**, wherein said value is stored in a non-volatile memory.

9. The method of claim **7**, wherein said system is a portable computer system.

10. The method of claim **7**, wherein said system is integrated into a single unit.

* * * * *